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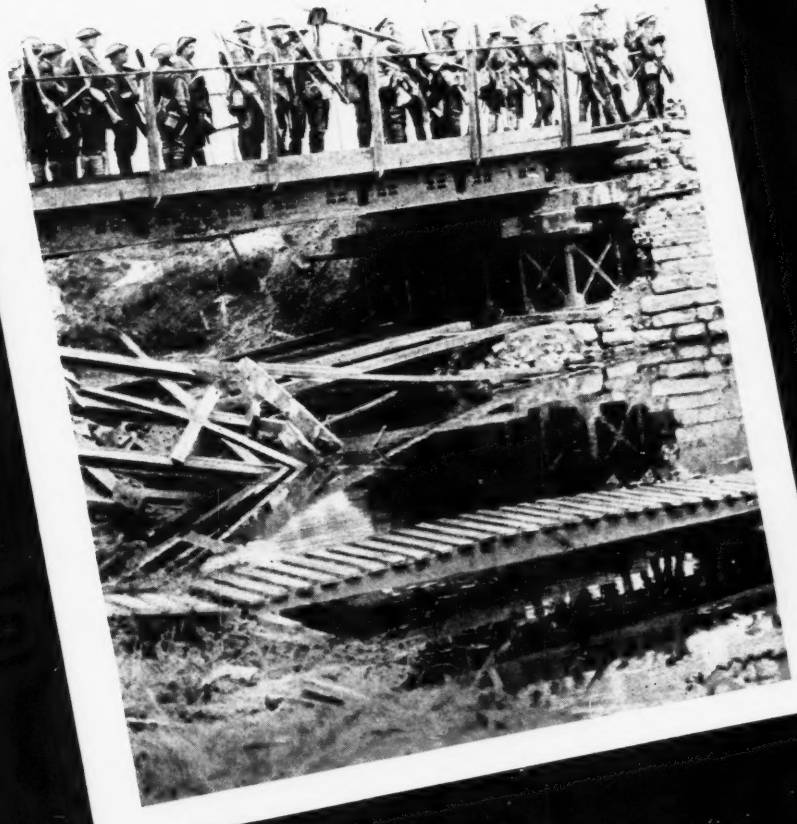

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Cover: Bridge replacement in France during last War—light infantry footbridge in foreground.

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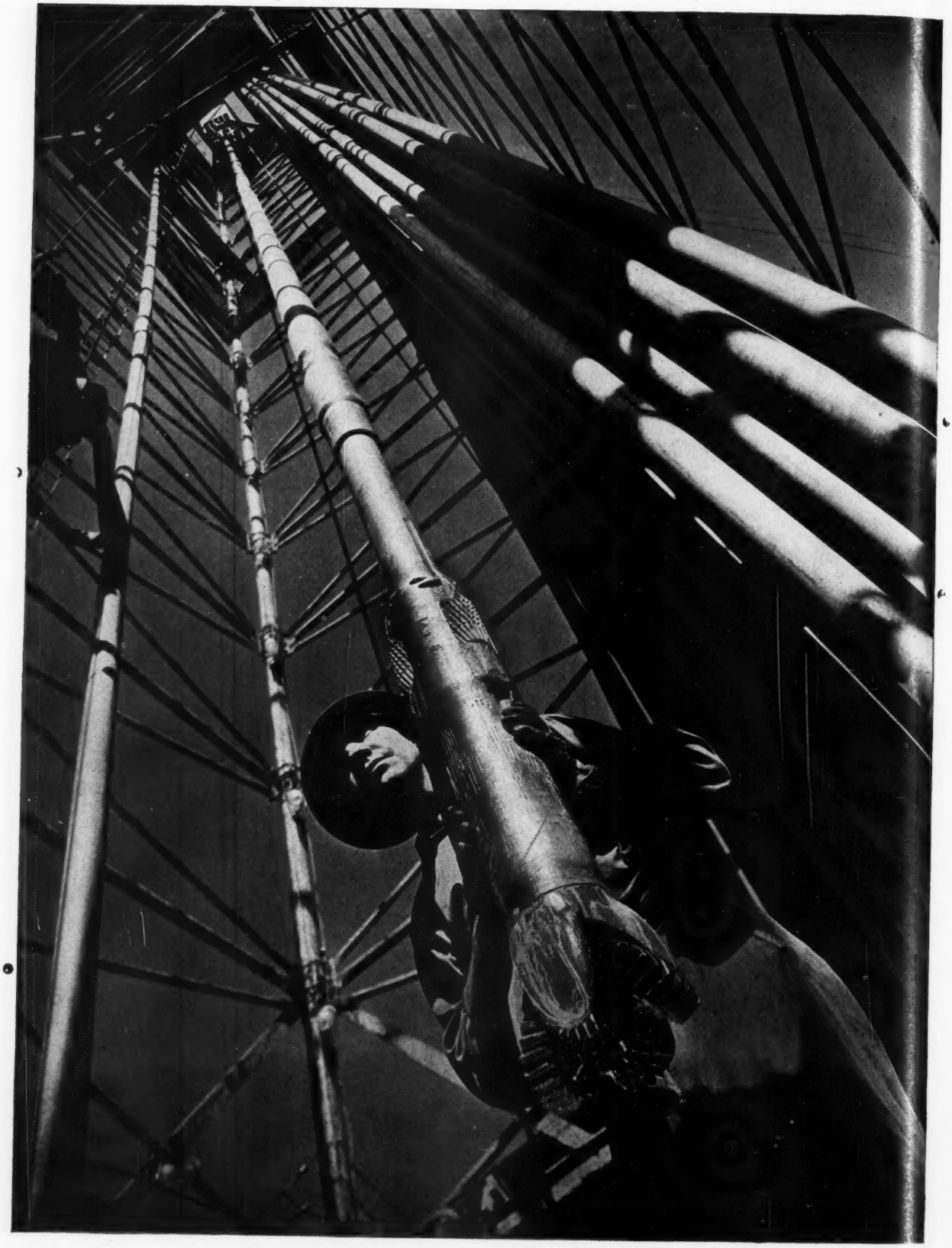


Lowering a Rotary Drill

(*See article on Controlled Directional Drilling, page* 8)

WARTIME FUNCTIONS OF ENGINEER TROOPS

By W. L. MALCOLM, Lieut. Col., Reserve R.C.E.
Director, School of Civil Engineering

Pictures from the "Illustrated London News" of 1917

THE writer has been asked to write briefly on the use of Engineer Troops in war. It is presumed particular reference should be made to the last war, since the writer's contact with the present one has been very small, in fact almost negligible, whereas he was with Engineer Troops in the last one for almost five years. However, it is his opinion that war does not change much during the ages. Only the materiel and the tempo change. A general of the American Civil War stated that the essence of war was to get there "the fustest with the mostest." This is as true today as it was then. The problem is still speed and manpower with an ample supply of materiel of all kinds. The internal combustion engine has entirely changed the picture in regard to speed and fire-power concentration, but the man-power must be there to direct all the engines of war. Since the speed of movement has been increased, the timing must be more exact.

War is a complex of motion and the lack of it. These usually are called war of movement or manoeuvre and trench warfare.

When war first breaks out, men are called to the colors (mobilized). The troops are concentrated, and then move toward the enemy or at least proceed to defensive stations in order to hold the enemy until such time as concentration permits offensive action. Such offensive action may, after contact with the enemy, continue, or it may end in a stalemate, or it may end in retirement. In the first and last cases the war of movement or manoeuvre continues, while in the case of stalemate when both sides hold their ground, the troops "dig in" establishing themselves in entrenched positions, and thus trench warfare develops.

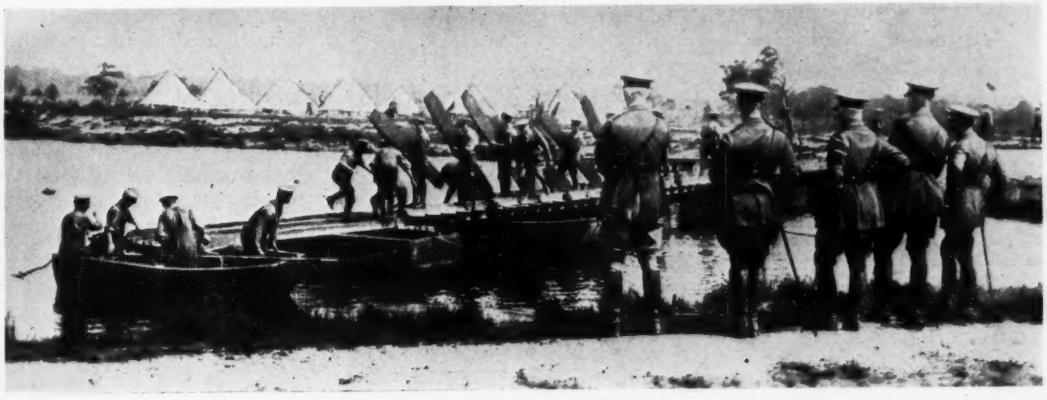
Trench Warfare

As noted in the previous paragraph, trench warfare results when neither combatant army can make progress against the other. This, of course, does not mean that everybody sits down and waits for something to happen. Each side endeavors by every means in its power to worry, annoy, and wear down the other. Shelling, trench raids, mining immediately become the order of the day. Shelling may develop to break down trench systems, to demolish roads and trainways, to demolish guns and gun emplacements in counter battery work, to disorganize troop concentrations either on the move or in camps or billets and generally to do as much destruction as is possible. Trench raids are for the purpose of morale, to obtain identification, and to accomplish destruction usually of course in the forward area. Tunnelling (mining) is for the purpose of blowing up the enemy lines and strong points, for destroying personnel, and lowering morale.

In order to understand how the engineering troops can be of service in this war of movement and in trench warfare, it may be of some assistance to give a brief statement of the organization of armies.

A fighting force of all arms may be of large size, composed of one or more armies. Each army is com-

Fig. 1 Officers supervise training in pontoon bridging



posed of corps and added army units. Corps are composed of divisions and corps troops. Divisions are made up of different arms of the service: infantry, artillery, engineers, medical and supply units, with certain divisional troops. In the last war the British Division was for the greater part of the war composed of three brigades (a regiment) each of four battalions of approximately 1,000 men, or 4,000 in the brigade; of artillery, three brigades; of engineers, a headquarters, three field companies, and a pioneer battalion, a supply train, called the Army Service Corps; an ammunition column; a divisional signal company; three field ambulances acting under a divisional staff medical officer; and certain divisional cavalry, cyclists, and other auxiliary units. A division was usually thought of as about 20,000 officers and men all told.

Types of Units

The interest herein lies in the engineer units, which as noted in the division consist of a headquarters, three field companies, and a pioneer battalion. The rank and file of the pioneer battalion is not as well trained technically as it is in the engineer units. Pioneers may be considered more as a work unit than the more technical engineers.

As noted, corps and armies have troops other than divisions. The corps must have troops to service the divisions, and armies must have troops to assist corps and so on down to lines of communications units and supply units at bases. All the various formations must have engineer units of one kind or another.

Corps and army units, usually designated by such names as Army Troop Companies R.E., Workshop Companies, etc., are utilized in many ways. For example, in trench warfare a good many trench walks, and much revetment materials are made by so called corps or army R.E. units.

Specialized troops in bridging and in railway companies or battalions, for construction, maintenance of way, and operating units, are held largely under Army or G.H.Q. control but may be sent to assist corps and divisional troops, if the need arises. In the last war the British had a good many railway battalions of engineers of which some dozen or more came from Canada.

Troops for tunnelling are also corps or army units. They are employed for driving tunnels under the enemy lines, for counter mining, and for deep dugout work. These refer normally to trench warfare activities. During attacks, these units are used as working troops and are included in the general reserve.

When tasks are too large for the divisional engineers alone, corps or even army engineer units may be allotted to assist in the work, or the work may be done directly by such units.

It must be noted that engineers are also combatant troops and are trained as such. In the last World War there are many cases where the engineer units were employed as infantry. They have always been considered as reserves.

Functions

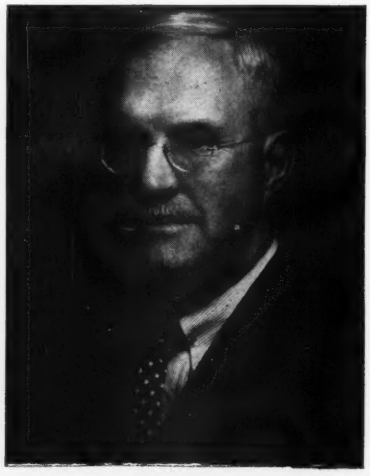
Engineers are service troops. They provide many necessary things to assist other corps such as infantry, artillery, air force, medical corps and others. Material must be provided for the forward area, the reserve area, and lines of communication, and certain materials, called in the army engineers stores, have been placed with the engineers for supply as required.

Engineers are service troops, too, because they give technical advice to other units and do technical work so that other troops may continue to function properly. For example: water supply, bathing and washing facilities, bridging, repair of roads are all of a technical nature and will be done by engineers or under engineer supervision.

Engineer duties cover a wide range. A list of works in which the engineers play a dominant part would include field fortifications, as well as permanent ones; camps, water supply and sanitation; roads and railroads of many and varied sorts; explosives, demolitions, and obstructions; tunnelling and mining; bridging, rafting, and river crossing expedients; searchlight work; the manufacture and supply of many things—stores and equipment—required by and issued to troops; protection to all units. It is thus seen that engineer personnel has to be trained very widely, much more so probably than personnel of other corps. It takes a long time to train a "sapper" (engineer private in the British Army), and thus he should not be wasted. The number of engineer troops in any combined force cannot be large, and hence they should be used only on tasks for which they are trained.

In the early stages of trench warfare in 1914-1915 engineers were used to build barbed wire en-

THE AUTHOR



AFTER graduating from Queens University in Ontario in 1907, Dr. Malcolm remained there to teach. In 1914 he joined the Canadian Engineers and after five years of service abroad had attained the rank of lieutenant colonel.

In 1934 he received his M.C.E. from Cornell, followed in 1937 by a Ph.D. Since July, 1938, he has served as director of the School of Civil Engineering.

tanglements in no man's land to protect the front line. So many casualties were endured that the engineer units fell away badly in technical value. In consequence, the engineers were withdrawn from front line service except for technical advice and work was confined to support and reserve line work and communications. Instructions were issued as follows: "The man power of a field company is not very great - - - - - infantry should be attached to the companies to do unskilled labor of carrying stores and simple digging - - - - - ." "The personnel of the field companies being technical should not be employed on unskilled work except in case of emergencies."

It was customary practice when a field company was attached to a brigade, as was common in trench warfare, to have a permanent working party from the infantry attached for laboring work. A common practice was to have twenty-five from each battalion of the brigade (or one hundred in all) attached to the field company.

The divisional officer commanding the engineers acts both as a staff officer advising the general officer commanding the division in technical matters and as a regimental officer commanding the units. The engineers may thus act as a unit for some specialized job or may be divided and sent to assist other troops such as advanced guards, rear guards, troops holding trenches, etc., in their work.

To be more specific let us more precisely consider the duties of engineers under the two headings

(a) war of movement
(b) trench warfare

Duties

While the army is advancing, engineer troops should be attached to the advanced guard to clear away obstacles or to provide for bypassing them, to construct temporary crossings, and generally to assist in every possible way the advanced troops in their endeavor to proceed as rapidly as possible. These units are normally drawn from the divisional engineers.

Reconnaisance parties of engineers should be also in the advanced guard to look into the problem of bivouacs and water supply for the troops that follow.

Fig. 2 Obstructions to hinder British advance in 1917

If the army is following up a retreating enemy, it will most likely find that roads have been blown up, that mines have been laid at important crossroads, and that bridges have been demolished. The advanced guard engineer troops will only provide very temporary crossings, remove obstacles such as trees cut down, tank blocks, and traps. It is likely that only a very small part of this work will be done by the divisional engineers. The heavier portion of the work will be done by the engineer units following with the main body. Even corps and army troops may be sent up for very special work.

Railroad repair work will usually not be done by divisional units. In the first place, the units are required for more specialized tactical work; in the second place, the personnel does not have the necessary heavy equipment; and lastly, the personnel is too small (except perhaps the pioneer battalion) to make the necessary progress. Railway companies or battalions specially trained and equipped will be pushed forward as rapidly as possible by higher formations such as army or G.H.Q., to take care of this particular work.

When the resistance of the enemy increases, the forward movement will slow down, and the engineers may be required to bring materials (bridging for example) forward for further advance, if, as, and when made. They may also be employed in improving communications, and some may usefully be employed on siting of trenches in case forward movement does not further progress.

Organization

In the British Army the divisional engineer units of the last war consisted of three field companies and a divisional headquarters. The field company consisted of four sections (corresponding to infantry platoons), a headquarters, and a bridging train. Each section was a completely integrated unit having cyclists, tool cart, etc., and could be detached for special work or attached to any infantry or other unit for operations. The bridging train consisted of two pontoons and two trestles carried on three pontoon wagons. This could be turned over to any section or all three bridging trains of the three companies could be organized as one unit. The whole of this equipment could lay about 175 to 200 feet of medium bridge.

In advancing, such bridging equipment should be held as near the front of the main body as the commander thinks necessary.

So long as the forces keep advancing, the engineers are required for communications and water supply.

In the more recent World War mine fields have been placed in the way of advancing troops or in areas into which advancing troops may be driven. These must be removed at least sufficiently to make it safe for more troops to

(*Continued on page 26*)

DRILLING CROOKED OIL HOLES---INTENTIONALLY

By HENRY E. OTTO, JR., AE '42

Cuts courtesy of the "Petroleum Engineer"

NEXT to rubber, oil and oil products are today perhaps the most discussed resources in the conversations of the American people—especially here in the East with impending curtailment of gasoline consumption.

Last month newsreel pictures in theaters throughout the country showed the results of the shelling of the southern California coast by a Japanese submarine. At the water's edge were noticeable numerous closely spaced oil derricks, employing the method of controlled directional drilling first developed about ten years ago and now used extensively to tap offshore deposits hitherto impossible to reach by conventional vertical drilling. This principle of controlled directional drilling permits a driller to make a hole straight, slanting, or curved as he desires, and to trace out weird underground patterns as complex as a corkscrew descent.

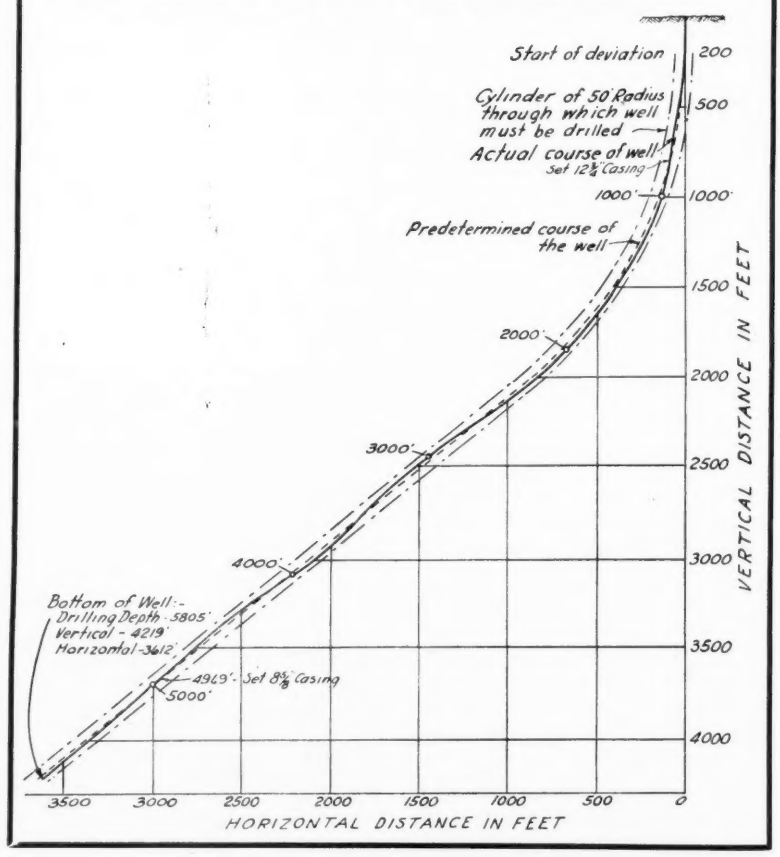
History

The story behind the development of this new method begins with an ex-salesman named H. John Eastman, who had been working in his spare time on instruments that might assure the drilling of truly vertical holes. Oil men had for years been trying to drill straight holes, and as a matter of fact even today a well is spoken of as "straight" if the deviation is not more than 3° from vertical. A minute's work on a slide rule will show that a 6000-foot well with a 3° deviation will find bottom within a circle of 314-foot radius—which encompasses an area of seven acres! And so the efforts of John Eastman were directed at a very important problem, for all kinds of controversies were arising because of underground collisions of casings which had started as much as 100 yards apart on the surface. Also there were disputes about draining oil from lands not owned by the driller.

It was while working on this problem that an idea struck Eastman—Why not drill holes crooked on purpose! In his work on straight drilling, Eastman had invented a device which enabled a driller to tell the exact location of the hole at every foot of depth and another gadget to guide the new well as it was bored. And so in 1932, after developing the necessary apparatus, he erected a derrick on Huntington Beach and applied his principle, drilling a well which curved downward and outward from the shore and under the ocean floor.

The drilling proved a tremendous success, and the well brought in 1000 barrels a day. Others were quick to realize the potentialities of the new method, and 90 such wells had been drilled before

Fig. 1. Course of well drilled to sand location below ocean



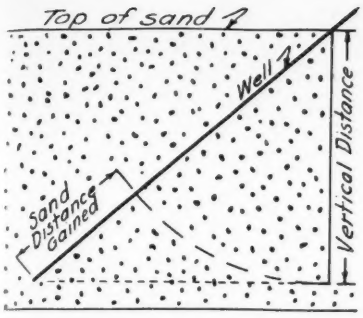


Fig. 2. A slant-hole well opens a greater amount of oil sand than does a vertically drilled well

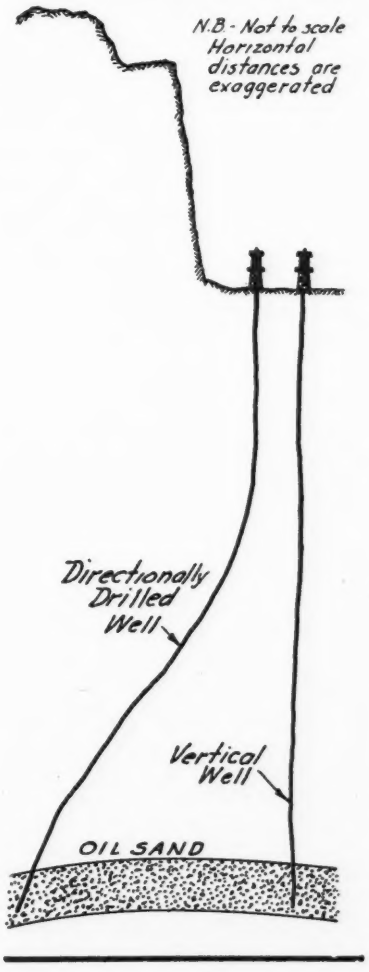
the city and state authorities began to picture the revenue possibilities from this offshore drilling area. Then an interesting situation developed, indicative of what was to follow in other areas where this method was used. Claiming the ocean bed as state domain, California collected $8,000,000 in royalties and would have received considerably more had not the United States Navy interfered and said, "What lies beyond low tide is open territory belonging neither to state nor corporation but to any power able to annex it"—implying the U. S. Government. Texas and Louisiana had similar problems. But the account of such legal controversies is a story in itself.

Method

The method and devices used in this kind of drilling are unusual. Eastman realized that in order to execute his scheme successfully he had to have control over two things. First, he had to know precisely the location of the bit at any given depth, and, secondly, he had to be able to change the direction and course of the bit. In his first attempts to establish the location of the well and ascertain its slant, Eastman used a simple method at that time widely used in the oil fields. It involved suspending a glass cylinder partially filled with acid in the well at the proper depth for a period of fifteen minutes; by the end of this period a horizontal line had been etched around the cylinder at the acid level, thereby giving the approximate slant of the hole. But this method was unsatisfactory because in addition to the slant the direction of the slant with respect to the true north had to be known so the location of the hole could be traced on a survey chart.

After trying a gyro-compass and several other devices and discarding them all, Eastman invented a complex instrument which consists of a thin metal cylinder five to seven feet long, containing batteries, a plumb bob, a compass, and a miniature camera. This camera photographs at regular intervals the face of the compass and the angle of the wall of the well, the shadow of the compass needle and the shadow of the slant of the well being recorded on special graph film. The driller puts the negative into a developing tank when the instrument is raised to the surface, and in five minutes he can read the figures on the graph and check them with his blue print. The whole operation of lowering this mud-sealed cylinder to the proper depth, taking the picture, and then raising the cylinder and reading the instrument takes only about thirty minutes.

Fig. 3. Topographical conditions such as here indicated often make the use of controlled directional drilling economical



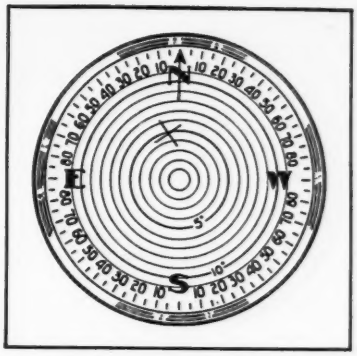


Fig. 4. Special graph film used to show deviation and direction of hole

But so far only one half of the problem has been licked. How is the straight casing to fit into the curved or oblique holes? Eastman hadn't at first given this problem much thought, being too absorbed in developing the precise locating instruments described above. But to everyone's surprise the pipe bent readily to conform to the curving hole, undoubtedly helped by the natural pressure and temperature below the surface.

Changing The Course

Nevertheless, a device had to be developed to make the pipe assume the desired path and guide the boring bit. This device, called the removable "whipstock," is a hard steel cylinder hollow at the top and three to ten feet in length, which is slightly larger in diameter at the bottom. The sides are grooved, and the bottom has a sharp point which is imbedded firmly at the bottom of the existing hole. By means of a collar just above the bit, the whipstock is affixed to the drill pipe and is then lowered and positioned at the desired angle. Passing down

through the collar, the bit on the drill pipe follows the slanting groove and bores the next portion of the hole in a slightly different direction.

When the slant bore is long enough to guide the bit forward without further assistance, the whipstock is brought back to the surface by raising the bit, whipstock and all. As the bit is raised, the collar engages the whipstock and carries it along. Once at the top the whipstock is detached, and the bit is lowered again to continue along its new course, while the whipstock rests idly by waiting for the surveying instrument to indicate that it is time for a new deflection to be made. This removable whipstock serves three very important functions: (1) to deflect the bit past a lost tool; (2) to straighten a hole; (3) to bend a hole.

Another method employs a "knuckle joint", which is a drilling tool so hinged that it can be deflected at any angle. Both methods enable holes to be drilled as much as 62° from the vertical, possible because a hole started crooked will become increasingly crooked. Thus, as it leaves the whipstock the pipe may be less than 10° from the vertical; but by continuing to curve the larger deflections may be achieved.

Other Devices

Since Eastman developed his instruments there have been many patents granted for devices to accomplish the same results with perhaps some improvement.

Among these are the Sperry-Sun directional single shot magnetic clinograph and the Lane-Wells magnetic surveys, both of which are limited to open (i.e., uncased) holes and employ the photographic principle and essentially the same instruments. Sperry-Sun has also developed a gyroscopic method, which may be used in cased or uncased holes.

A "sureshot" hydraulic deviation instrument uses two plumb bobs, each recording separately several seconds apart to act as a check on the other and insure that one plumb bob did not record while in motion. It differs from the other methods in that no acid, batteries, or photography are used.

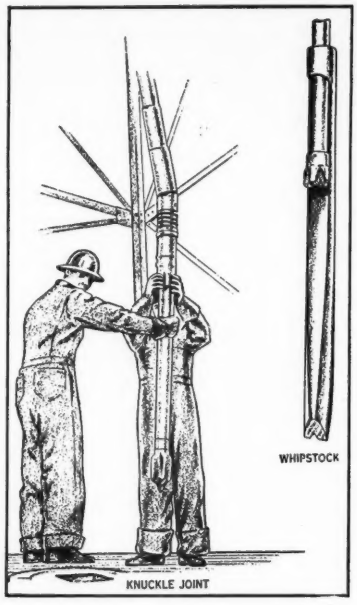


Fig. 5. Special apparatus

Drilling these holes requires considerable skill, for the instruments react differently to different strata and at different angles. For instance, up to a certain speed of revolution the bit drifts to the right, and in excess of this speed it drifts to the left; also, the bit tips and pierces at a right angle through hard, slanting strata, unless the slant is too great, in which case it slips along and starts off in the other direction. And these are only a few of the tricky problems.

Applications

There are many more uses for this type of drilling than at first come to mind. Drilling out under the ocean from derricks erected on land is perhaps the best known application. But it also permits the drilling of numerous holes from the same derrick, thus enabling oil to be extracted at a profit from source beds formerly too expensive to work by more common methods —as in the case of Elwood, California. It is now possible by the Eastman method to recover some of the 70% of the oil formerly left in wells no longer yielding production; the driller starts from any point along the casing, plugs up the bore below this point, then drills slantwise through the casing to some point where there is still sufficient pressure in the oil sand to drive the oil up. He can even curve a hole through casing and run it inside of and parallel to the oil-bearing strata, draining the sand by gravity. Source beds occurring under cemeteries, parks, or buildings can be tapped from a distance by this method. Drillers can follow geologic formations, avoid rock structures, go through faults, and under salt domes.

Salvage

There is one important use for this method of drilling, however, which is considerably different from those thus far mentioned—extinguishing "wild" burning wells which are raging unchecked. Eastman engaged in such a venture only two years after the successful drilling of his first curved well on the shores of Huntington Beach. A subterreanean gas explosion and resultant fire of a wild well known as Alexander I was threatening the entire Conroe oil field at Houston, Texas. The property adjacent to Alexander had been leased by the Humble Oil Company, and they saw the delivery from their wells decline steadily while Alexander wasted 9000 barrels a day. One of the Humble officials who had heard of Eastman's success in California called Eastman and offered him $300,000 to check the well. Asked if he could hit within 50 feet of the bottom of Alexander, Eastman confidently staked his reputation and said that if he didn't get within 25 feet of it, the company need not pay him. The derrick for this rescue well was erected behind a steel fire shield 400 feet from the crater's edge. When, after eight weeks, his calulations showed him to be a mile deep and within six feet of the spot for which he was aiming, water under a pressure of 1800 psi was pumped into the slanted hole he was drilling. The pressure fell, indicating that the water had been forced through to the bottom of Alexander, and within 24 hours the well stopped flowing, corked from the bottom by the weight of the water column. There have been numerous other examples of this type of salvage, not only in Texas, but in Venezu-

(*Continued on page* 22)

MEAT PRODUCTION IN A TYPICAL PACKING PLANT

By WILLIAM D. KNAUSS, AE '46

Photographs courtesy of American Meat Institute

TODAY the meat packing industry ranks at the top of all food industries in the United States. Each year 100,000 men are employed in the production of this foodstuff so vital to good health because of its richness in vitamins, especially Vitamin B. Shunned by a large number of the American people in years gone by as a carrier of disease and as a danger to good health, meat is now carefully handled in thousands of meat packing plants throughout the United States under the watchful supervision of United States Government inspectors. In order to get some idea of how a meat packing plant functions, it will be best to follow the operations of a typical meat packing plant.

This typical plant is located in Fairview, a suburb of Poughkeepsie, New York. This firm was established in 1892 as a small market in lower Poughkeepsie and now has grown to a large two-story packing house. In this plant, which has 36,400 square feet of production space, 80 men are engaged in the various processes necessary in preparing hogs or cattle as meat products for public consumption. A compact plant in which all operations are carried out under the one roof, it has a production capacity of 150 cattle and 1200 hogs a week.

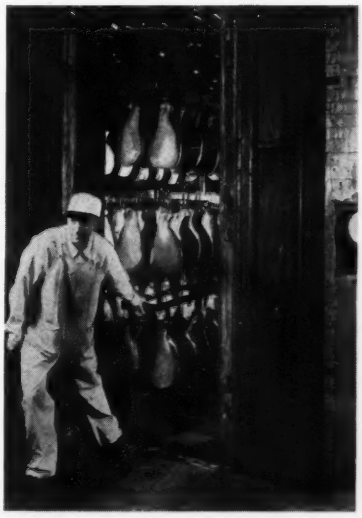
Disposal

Coming in from the west by fast freight, the hogs are unloaded at the company's private railroad siding and are unloaded, weighed, and quartered in well-ventilated and well-drained sheds. Operations commence at the plant at 6:45 each morning and a regular routine calls for slaughter-house operation on Mondays. The hog begins his journey through the production line by being placed on a continually operating hoist. After slaughtering, the hog continues along a well organized production line to a scalding tank where it remains for five minutes —just long enough to loosen the hair and scurf. The temperature of this tank is automatically maintain at 140° Fahrenheit.

Hair Removal

Passing along the line, the hog next goes to the dehairing machine where the removal of the hair and scurf is accomplished by steel clips which are attached to rubber beaters projecting from a steel drum rotating at a moderate rate of speed. Within the short time of five minutes, the hog has passed on a mechanical hoist from the dehairing machine to the gambrielling table, where steel gambles are inserted in the hind leg tendons, and on to an overhead trolley. A United States Government inspector from the Bureau of Animal Husbandry, Department of Agriculture, makes his second inspection of the hogs at this point, having previously conducted an ante-mortem inspection. It might be added at this point that the inspector is on duty at the plant at all times, always making daily routine visits to all parts of the plant to see that strict sanitary conditions are observed. As the hogs move down this systematic production line, the operations divide themselves into two categories: those dealing with the edible part of the hog and those dealing with the inedible part. The carcasses are sent to refrigerated holding rooms, where they are chilled before proceeding to the cutting department, and the inedible material is sent to the inedible department adjacent to and directly below the slaughtering department. To dispose of a whole shipment of hogs takes most of the morning, and in the afternoon operations begin in the other departments.

Fig. 1. Hams leaving smokehouse



Cooking

The inedible material is passed through grinders, hashers, and washers in rooms adjacent to the slaughtering department and then is sent through a chute downstairs to horizontal steam-jacketed cookers. Constantly agitated by steel paddles, the product is kept in these cookers for a period of one and a half to two hours, during which an American Marsh steam pump and jet condensers maintain a partial vacuum. While these operations are being carried on under a pressure of 40 pounds per square inch, Foxborough re-

cording thermometers give a graphic record of the cycle of operations. The tanks are steam trapped, and the condensate is returned to the boiler.

Pressing

Upon completion of the cooking, the product is placed in a hydraulic press which consists of a steel curb and ram. Operated by a high grade oil, it is capable of exerting pressures up to ten tons per square inch. Prior to this, the grease and oils were removed and pumped from large holding tanks to storage tanks, ready for shipment to manufacturers who will turn them into the soaps used in our homes. In the press, the ram slowly descends on the alternate layers of material and steel discs, pressing the combined masses until the remaining oils have been removed. The resulting product is a high protein material used for animal feed.

Even the blood is a valuable by-product and this is converted into dried blood—a rich fertilizer for gardens and lawns—by a cooking and dehydration machine operating under a closed system with vacuum. This completes a typical day's operations in the plant.

Fig. 2 Trimming hams prior to processing

Early Tuesday morning, the chilled carcasses are removed from the refrigerated holding rooms where the temperatures are maintained at 36° Fahrenheit by means of heat absorbers, operated as part of an ammonia direct expansion refrigerating unit. These units consist of a coil over which air is drawn, first through a brine spray and then through moisture eliminators, circulating and recirculating the chilled air through the refrigerated storage rooms. Not only does the brine spray, which is maintained by a small centrifugal pump, increase the refrigeration capacity, but it also keeps the coils free of frost. The pH value of the brine and its specific gravity are constantly watched both day and night.

Cutting

As mentioned above, the chilled carcasses are removed from the refrigerated holding rooms early Tuesday morning and are cut up for further processing. Of course those cuts finding a ready market, such as fresh pork cuts, are sent directly to the refrigerated shipping rooms, where they are labeled and packaged for wholesale distribution by the fleet of twelve trucks maintained by this firm. With deadly precision the carcasses are cut up into the tail, the hind feet, the hams, the pork loins, the bellies, the spare ribs, the fresh shoulders, the neck bones, the hocks, the front feet, and the jowls. The main cuts are made by the chief butcher, and each of these are again subdivided by a staff of twelve men.

At one side of the cutting room is an odd looking machine, somewhat resembling a table-top sewing machine, which removes the skin from the fat of the pork product. These skins are made into gelatin. Each cut, after it leaves the cutting room, either goes to additional refrigerated holding rooms where it is held until packaged for wholesale distribution or to other departments where further processing takes place.

Making Sausage

The sausage department is next to the cutting room. Here ten men work at stainless steel tables, at the moment producing the popular meat product, the frankfurter. The frankfurter is a meat product, not a meat cut, and consequently has a definite formula. The ingredients for this product are passed through a grinder, several hundred times as large as the ones used on electric mixers in the average home, and then go through a chopper and giant mechanical mixer. This meat mixture is then placed in a stuffing machine which operates under compressed air, forcing the mixture into natural and artificial casings. All during the processing of this product, human hands do not touch the mixture, and temperature—an important factor—is maintained by the addition of cracked ice. The casings fill almost instantaneously and are then "twisted" into uniform lengths by an automatic linking machine or by hand, depending on product. In this endless line of production, the frankfurter then enters the smoke house, carried by a steel car travelling on an overhead rail. In the smokehouse hardwood smoke filters up evenly in the air-conditioned chamber, maintained at closely regulated temperatures. The frankfurters leave the smokehouse and enter adjacent cooking tanks, where the temperature is maintained at a fairly high level. The frankfurters in the cooker will, after a period of time, be removed and stored in a smoked meat's refrigerated holding room prior to packaging for distribution. This completes the tour of the sausage department.

All fat is taken to the lard department and deposited in large pressure cooking tanks and subjected to direct steam at a pressure of 40 pounds per square inch. Processing is completed after two

and a half hours. Upon entering an adjacent room, snowy white lard may be noticed issuing from a tap and being stored in fifty-pound tubs, ready for shipment. Before reaching this room, however, the actual cooking and settling operations take place in which the pressure was gradually reduced and the lard drawn off through filters into holding tanks. It was then chilled over a rotating, refrigerated steel cylinder, and was coagulated before being pumped to this room. Lard is the rich meat by-product that is the healthiest of all shortenings.

Curing

In the curing department in a nearby section of the plant, fresh hams, fresh shoulders, and fresh bellies are processed in over a hundred vats. These vats contain a brine solution in which the above products remain for a certain period of time. A unique machine automatically calculates the proper amount of solution necessary to be injected into each ham. Bacon, processed from the pork bellies, passes from this room to the smoke house, where it receives a hard-wood smoke before being placed in a freezer; it is then shaped and pressed by a compact press capable of exerting upwards to a ton of pressure before being sent to storage in a large freezer prior to packaging.

Upon entering the refrigerated storage rooms, a staff of men may be seen busily engaged in packaging and weighing frankfurters, sausage, boiled hams, and various other products; each product must be properly labeled to show that it has been inspected and approved by the United States Government inspector.

Beef

Wednesday is beef day at the plant. Since beef undergoes operations similar to pork, it is obviously unnecessary to follow its path of production. This, too, is United States Government inspected.

Of direct importance are the refrigerating machinery and industrial waste plant. The compressors which supply the various refrigerating units are housed in one central room and are operated at back pressures necessary to maintain the desired temperatures. The condensers operating in conjunction with these compressors are of the two-pipe construction, the cooling water for these condensers bein recirculated through a cooling tower. All of the refrigerating compressors are of the vertical twin-cylinder type. It was decided to use a group of smaller machines for flexibility of control, and based on a twelve-month operation period they have been found to be more economical to operate because of the fact that during the winter months several units can be shut down completely.

Fig. 3. Twisting sausages by hand before entering smokehouse on the trolley in foreground

Steam

Steam is produced solely for processing and not for power purposes. It is obtained from the operation of two horizontal 100-horsepower return tubular boilers. These are operated by stokers with automatic controls for draft, boiler feed water, and pressure.

Due to a relatively high volume of industrial waste, the plant found it advisable to construct its own disposal plant. After many tests were made on samples of raw effluent for B. O. D. (biochemical oxygen demand), data was compiled which furnished a basis for the design of the plant. Mr. Henry Pfisterer, C.E. '30, was the consultant in preparing the plans. The plant is of the biofiltration type, consisting of grease separators, primary and secondary clarifiers, and biofilter. One of the unique features of the design is the low cost of operation, from the standpoint of both electrical consumption and manpower. Power for operation is supplied by two ¾-horsepower and one 2-horsepower motors. This industrial waste plant is capable of disposing of 50,000 gallons a day.

These, without exception, are the operations which take place in varying degree of size in every meat packing plant in the United States, the degree depending on the facilities of each individual plant. Each plant also maintains its own fleet of trucks which are used for wholesole delivery of the various meat cuts and meat products. This firm in particular operates a fleet of twelve trucks and sales coupes which are housed in a separte garage adjacent to the plant itself. These are in constant operation five days a week, each travelling over established routes every day. The trucks, all specially equipped with up-to-date refrigerated bodies (except those used for local delivery), distribute the meat cuts and products produced in the plant to neighborhood markets from which consumer purchases are made.

Conclusion

This, then, completes a tour of this plant. We have seen every operation that is carried on, each being part of a system of production that operates with a maximum of efficiency.

AROUND THE COLLEGE . . .

Accelerated Program

After many weeks of planning the Engineering College has adopted an optional accelerated program by which four- and five-year students may complete their courses in less time by attending school through the summers. A $200,000 fund has been set up by the University trustees for emergency use during 1942-43 in helping students to take part in the accelerated program.

For four-year men the plan calls for eight fifteen-week terms of academic work at Cornell and one summer (the second) under the direction of the college in gaining practical experience, either in related industrial work, in field work, or in one of the programs of the Army or Navy which permits students to complete their course, but offers summer military training. Students will be graduated in September, three years after entrance. Students entering a five-year course are permitted to follow a similar program; they take ten terms at Cornell, spend their third summer gaining practical training, and graduate in June of their fourth year.

The new program allows first-year students to be admitted either June 29 or September 28, admission in June making possible less intensive schedules in succeeding summer terms. Some who are juniors at present will be allowed to take the accelerated program, which starts June 1, but some will provide the normal course, having already contracted for summer employment.

The status of the present sophomores depends on their individual school. EE's and ME's who wish to take the new program must stay in Ithaca both summers, since they have already had a summer free for practical work. CE's who take the accelerated program, however, need to spend part of one summer in surveying camp, and hence will not be able to graduate until February, 1944.

In describing the new program, Dean S. C. Hollister made the following statement: "The College of Engineering believes that during the present emergency more rapid training of engineers is essential, and the faculty is ready to do whatever may be necessary to provide such training for our students." The Dean made it clear, however, that no student will be compelled to take the new program. "This program," he said, "is supplementary to the regular courses, so that students not in a position to take advantage of the acceleration may continue in the regular courses as at present."

Making the summer out in industry a regular part of the engineering course is an innovation, made advisable, according to the faculty resolution, by the fact that practical experience is a vital part of the education of every engineer.

A total of 1,308 freshmen, sophomores, and juniors are eligible to make application for the summer term. This will probably mean that Cornell will have the largest attended summer session since World War I, when the Student Army Training Corps was in training here.

Tau Beta Pi Elects

Class of 1942

John Gray Aldworth
George William Bouton
John Melchior Hansen
James William Hart
Paul W. Leighton
William Frederick Voecks

Class of 1943

Scott Lane Brown
David Joseph Coons
Ellsworth Fisher Filby
Frederik Cheney Gjessing
Louis Gaston Helmick, Jr.
John Thomas Hodges
Donald Lambin Johnson
Roy Verner Johnson
Richard Malcolm Junge
George Bovier Marchev
Tom Otto Nobis
Dean Bussman Wheeler

Professor Thatcher

Professor R. Y. Thatcher of the School of Civil Engineering represented Cornell at a recent New York City Conference to discuss methods of organizing and operating safety engineering classes and to plan for future classes in the Middle Atlantic States. The Conference was called by the Department of Labor through its National Committee for the Conservation of Manpower in Defense Industries.

As a part of its general Engineering, Science, and Management Defense Training Program, Cornell recently established courses in industrial safety in Binghamton, Corning, Cortland, Elmira and Endicott with a total registration of 150 men. Professor Thatcher is supervising these courses.

The classes, instructed by professional safety engineers selected from the local industries, are designed to assist plants having war contracts by the training of key supervisory employees, who have the responsibility for maintaining the safety, health, and efficiency of the persons employed. The aim is to provide the knowledge and skill required by the supervisor, who in turn will impart to each worker those practices and procedures needed to keep the worker safe on the job.

Miss Mead

By joining the regular staff of control operators at WHCU, Beatrice Mead, EE '42, recently received considerable nationwide publicity as the only woman radio control operator in the country. She thus is setting an admirable example to women throughout the country in showing how women with technical skills can release men for fighting service.

Miss Mead is the first woman in twenty years to take the straight electrical engineering course at Cornell, and she is one of only three or four in the entire history of the school. A member of the Sigma

IN MEMORIAM

ADAM C. Davis, M.E. '14, professor of experimental engineering and head of that department, died of coronary thrombosis Tuesday evening, March 17, in the Memorial Hospital.

Born in 1889 in Goldsboro, North Carolina, Professor Davis received his preliminary education in the Goldsboro schools, and he attended Virginia Polytechnic Institute for two years, followed by four years at Cornell. Upon graduation from Cornell Professor Davis became an instructor in engineering, and, except for the two year period from 1917 to 1919, when he was a consulting engineer in industry, he has been teaching at Cornell ever since. In 1919 he resumed his teaching as assistant professor and in 1925 was named professor of experimental engineering, becoming head of the department in 1936.

During World War I, he was an instructor in the U. S. Army School on military aeronautics. He has since been engaged in experimental engineering, commercial testing, research, and the supervision of such work. He also conducted considerable research on foundry sands for the American Foundrymen's Association.

Professor Davis was in charge of the diesel engine training of the U. S. Naval Reserve ensigns and of an investigation of fuel knock inhibitors, the effect of atmospheric humidity on the performance of gasoline engines, flame propagation, the development of commercial internal combustion engines, the investigation of brake drum materials, and a number of other engineering problems.

Professor Davis was a member of Tau Beta Pi, Atmos, Phi Kappa Phi, SPEE, the American Society for Metals, and the American Foundrymen's Association.

Kappa sorority, she has been active as Secretary-Treasurer of the AIEE and received the Carl Richard Gilbert Award for 1941-42.

Under an apprentice policy established by Michael R. Hanna, general manager of WHCU, any capable student in the communications course is eligible to apply for a position as control operator. Interested students with ability are accepted in their freshman and sophomore years. They gain experience to qualify for jobs in their junior, senior, and graduate years. This personnel development program is under the supervision of the communications department faculty of the College of Engineering.

The Sad News

BECAUSE of the many varied rumors about the campus concerning the number of bustees this February, we have secured the following information directly from the respective school offices. At the end of the first term, 9.1% of the CE's were dropped for scholastic reasons; 8.6% of the EE's; and 12.6% of ME's. The sophomore ME's lost 19.4% of their class. (No figures are released by the School of Chemical Engineering.)

Tell Berna Returns

TO the senior lecture group on Friday, March 13, Tell Berna, M. E. '12, general manager of the National Machine Tool Builders' Association, described the task which faces industry in turning out the materials needed so desperately in our war effort.

Pointing out how quickly war materials are used under actual combat conditions, Mr. Berna stated that it took $350,000 worth of torpedoes to sink the "Bismarck" alone. He said that it is impossible for the ordinary layman to conceive the vast preparations and tremendous quantities of ammunition, gasoline, and transportation facilities that are needed to wage war offensively. "People seem to think," he said, "that one moment after raw materials are fed into one end of a manufacturing arsenal, finished Brownings will appear at the opposite side ready to be shipped and used; the rigid specifications that must be observed in the manufacture of munitions are overlooked, and the public wants to know why production fails to keep pace with our needs." To give an idea of the exactness of production, Mr. Berna pointed out that all of the 9600 parts in an airplane engine must be rigidly inspected; this requires fixtures and gages, as well as skilled men. As for complexity of the materiel that must be produced, he simply remarked that Chrysler's government order for the M-1 tank was accompanied by 850 pounds of blue prints.

"We must think now of what we shall want and need eighteen months from now," Mr. Berna went on to say. "Industry needs time to tool up before it can be expected to turn out war materials in effective amounts."

Mr. Berna concluded his lecture with a discussion of the priorities system and the confusion it is creating among the manufacturers.

Hart Speaks

ADDRESSING the senior engineers on Friday, March 20, on the topic "Conservation of Strategic Materials," C. D. Hart, '06, told how the Western Electric Company is replacing essential metals and fabrics used in the manufacture of Bell telephone, by other products still available in large quantities.

Mr. Hart showed samples of various parts now being made of

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Editor-in-Chief Sfat

Mircea R. Sfat

IT SEEMS that "Mike" (he's called that because it's easier to say) was marked for distinction from the very start. He was born with the family name of "Sfat" which is probably one of the uncommonest names in existence; about twelve people possess it. Born in Rumania, his earliest years were spent in a building which had once been the officers' pavilion of the Fort of Timiscoara.

When he was two and a half years old, his family came to the United States and settled in Michigan. They have lived in that state ever since.

Coming to Cornell was almost an accident. Originally, he had intended to enter the University of Michigan because of its nearness to his home. However, he happened to notice an announcement of the John McMullen Regional Scholarship. Purely as a stab, he applied. He got the scholarship. As he said, "I had some luck."

During his frosh year here he "didn't do much". He merely studied hard (which he has done ever since), made the Dean's Honor List, and was elected to Retort and Beaker. He also entered the chimes competition but was dropped in the last cut.

The summer after his frosh year was spent working as a control chemist for the Federal-Mogul Corporation of Detroit. There he obtained valuable experience in the field of analytical chemistry.

In the fall of his sophomore year he went out for the CORNELL ENGINEER competition and was elected to the sophomore staff. Thus began his climb to the editorship. The publication did not occupy all of his time, however. He pledged Sigma Pi fraternity, was elected secretary of Retort and Beaker, and again made the Dean's Honor List.

Instead of returning to a chemical job during the following summer, Mike decided to try something in an entirely different field. He felt that summer work in a chemical plant was not the best insurance for a healthy school year to follow. Accordingly, he started out as an apprentice carpenter in the North Molder Co., a contracting firm in Jackson,

(*Continued on page* 24)

Joseph L. Boyer

JOE has made a good mark for himself during his four years at Cornell, for along with his good scholastic standing in the School of Civil Engineering he has kept up a number of outside activities as well. He came here from high school in Palmerton, Pennsylvania almost four years ago and hasn't been wasting his time.

Joe had his eyes on Lehigh, Cal Tech, and Cornell as the three schools in which he was interested. When he finished high school, he started out west with a number of his pals to see what Tech was like. He got stranded in the Ozarks, never got to California. Later he decided that Lehigh was too close to home, and, since he had been up to Cornell on Cornell Day and had liked it a lot, he showed up here that fall. He earned a McMullen Scholarship at the end of his freshman year which he held for a year and a half. As his senior option he is taking structural engineering.

For extra-curricular activities, Joe got into frosh baseball and then switched over to cheerleading for the remainder of his curriculum. In interfraternity athletics he has excelled in football, baseball, basketball, and tennis, and has been athletic manager of his fraternity, Theta Chi, during his senior year. He is a member of Pyramid and has also been on the Sophomore Smoker Committee and the Senior Ball Committee. Last, but by no means least, his excellent services on the CORNELL ENGINEER made him circulation manager in his junior year, followed by the position as business manager in his senior year.

During the summer of his freshman year he worked in the construction and maintenance department of the Palmerton Sewerage and Disposal Company, while in the summer of his sophomore year he worked as an inspector of construction on sidewalks, curbs, and buildings for the William Jones Construction Company. He had made plans for the summer of his junior year while in school, but the day before he left he got a call which resulted in a job on one of the new huge army cantonments, working in the firm of Charles H. Hurd '96, in Indianapolis. This was a wonderful opportunity, as he was designing pump houses, etc.,

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Business Manager Boyer

ENGINEER BOARDS . . . .

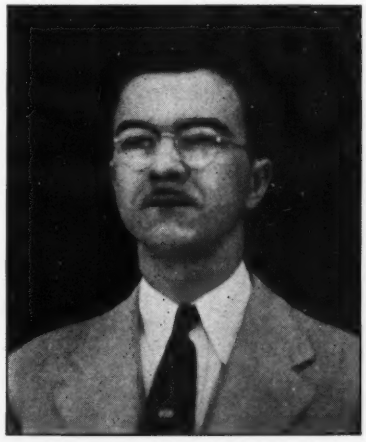
Ernest S. Walker

His name is Ernest Samuel Walker, Jr. To his friends he is just plain "Ernie". Being a student, adventurer, and business man has occupied the majority of his time during the last four years. For the past year, Ernie has been chiefly business man; it is he and his staff who are responsible for this magazine reaching you. Ernie, you see, is circulation manager.

For the last sixteen years Waverly has been Ernie's base whence he has ventured forth to high school, to preparatory school, to Florida, via the thumb, and last but not least, to Cornell.

Completing his high school career in 1937, Ernie took a post-graduate year at Riverside Military Academy in Gainesville, Georgia, where, in the short space of one year, he distinguished himself by playing soccer and managing the track team. With no end of knowledge tucked under his belt, slender Ernie entered the School of Civil Engineering in the fall of 1938, the year remembered by the hurricane that struck the eastern seaboard soon after the opening of college. Then began the "diploma or bust" duel. It looks now as though the diploma will get the decision with the end of hositilities scheduled for the middle of May.

Circulation Manager Walker



Besides being a prominent member on the staff of the largest engineering college magazine in the country, Ernie has been elected to Pyramid, the civil engineering honorary society. His election was a just reward for his scholastic efforts.

During his "vacations", many different activities have occupied his time. In the summer of 1939, Ernie, after nine years of service at the Elmira Y.M.C.A. camp on Lake Keuka, became a counselor there, where he remained until late in the summer. However, the spirit of adventure took hold of him, and on September first, he and another chap set out for Florida. Oh no, not by train; by the thumb, with twenty-two dollars apiece! Hitching rides in flivers, Buicks, Zephyrs, and what have you, they reached

(*Continued on page* 24)

Henry E. Otto, Jr.

Harry came to Cornell from Richmond Hill, New York, where he had heard many glowing accounts of the University from members of his family. Being equally interested in engineering journalism and petroleum engineering, he took the course in administrative mechanical engineering. His journalistic activities have been many. For four years he has worked with the Cornell Engineer and is now managing editor. In this capacity he has inaugurated several new ideas and encouraged several others; it has been his responsibility to line up the articles for each issue, to see that they are written and arrive on time—a job which he has done most successfully.

The Engineer has not been his only activity along journalistic lines, however. It has shown up to a less degree in his election as secretary-treasurer of the ASME for the past year and in his work as treasurer and former secretary of his faternity, Pi Kappa Alpha. Interested in debating long before

Managing Editor Otto

he came to Cornell, his desires to engage in this activity had to remain dormant until in his senior year he found the time to become a member of the Cornell Debate Association and participate actively in club discussions.

During the indoor polo season Harry is quite busy as varsity manager, and while doing all this he has managed to keep high in the top quarter of his class. In recognition of these activities he was elected to Kappa Tau Chi and Sigma Delta Chi.

Having taken a secretarial business course before coming to college, Harry, during his freshman summer found himself engaged as a stenographer in a claim adjustment bureau; during the summer following his sophomore year he worked for a large New York insurance company. Taking dictation from some company official is an excellent opportunity, he believes, for a young fellow to learn important facts about executive work as well as about the type of business in which he is employed.

One of the many engineers enrolled in advanced R.O.T.C., Harry will receive a commission in the Ordnance Department upon graduation. Summer camp at Aberdeen Proving Ground, Maryland, proved quite an experience and was an excellent opportunity to meet and live for six weeks with men from six other eastern engineering colleges. Harry vividly recalls a lecture on the M-1 tank given on a hot afternoon in July; the technical sergeant drove the tank into a

(*Continued on page* 24)

THE ALUMNI . . .

J. A. Bion Dies

JOSEPH Arnold Bion, who did graduate work in electrical engineering at Cornell in 1893 and 1894, died on January 30, 1942.

Shortly after his work here, he became chief draftsman and mechanical engineer for the Chicago Great Western Railway, serving for two years before he was promoted to manager of the St. Louis office, where he served two years more. In 1892, continuing his rapid advancement, he became consulting engineer for the Thomson-Houston Electric Company, Chicago. While there, he was engaged in the design and construction of the Columbian Intramural Railroad for the World's Columbian Exposition at Chicago, one of the first electric elevated railroads in the United States.

Besides these positions, Mr. Bion did construction work for the Chicago-Milwaukee Electric Railway and the Lansing, St. John, St. Louis Railway; he played an important part in the electrification of the Grand Trunk Railway and the Grand Central Terminal in New York City; he was consulting engineer for several United States cities on surface and underground traction problems.

In World War I he made a survey of aircraft supplies and production facilities for the United States Army and Navy and had charge of development and production of aerial torpedoes.

A pioneer in the development of single-phase electric traction system and the standard ac-dc system, he was the author of numerous technical articles. He was a member of the American Society of Civil Engineers and the Society for the Promotion of Engineering Education.

Girard Honored

PETER F. Girard, C. E. '22, was recently honored for his work on the design and construction of Chicago's new subway system. His paper, recounting the problems which were met in this subway construction, was presented to the American Society of Civil Engineers last fall. An article taken from this paper was published in a recent issue of CIVIL ENGINEERING.

After his graduation from Cornell, Mr. Girard spent two years with the Boston water supply department doing design work and fourteen years with the Sanitary District of Chicago on tunnel and other heavy construction work. Since the initiation of the subway construction work in Chicago in 1938, he has been Assistant Chief Engineer on that project.

In The Service—

Hoffman To England

SENT to England for training in the operation of secret airplane locator systems, Norman Hoffman, former graduate student at Cornell who is now with the Electronics Section of the Army Signal Corps, is rapidly becoming acquainted with those systems which have been of great service to the British during the heavy German night bombing raids.

Writing to Professor William C. Ballard, Jr., of the School of Electrical Engineering, under whom he studied, Hoffman related that he had met Charles Collingwood, '39, who rounds up the news from England in a daily CBS broadcast at 8 a.m. While at Cornell, Hoffman was employed as control operator in the WHCU studios.

Davis In Virginia

LIEUTENANT Richard G. Davis, C. E. '41, since the Poughkeepsie regatta has been hiking in the mountains of Vermont, has worked as an estimating engineer in Pittsburgh, has done research engineering in drydock construction at Newport News, and with the 44th Engineers "fought" through the Carolina maneuvers. Today Dick is the adjutant of the 31st Engineer Combat Battalion, Fort Belvoir, Va.

Ross In Canal Zone

WE HAVE received the following letter from Robert Ross, A.E.M.E. '41, who was the former editor-in-chief of THE CORNELL ENGINEER and is now stationed at 558 Signal A. W. Bn., Fort Gallick, Canal Zone:

"Since graduating last June my life has been far from dull. During the summer I spent three weeks in the Rockies, camping, panning gold, horseback riding, exploring, and growing a beard.

"At the end of the summer, I was called to active duty as Second Lieutenant in the Signal Corps. After two weeks at Fort Ontario, I flew down to the Louisiana maneuvers, where I was a messenger center officer for the 101st Signal Battalion attached to the Fifth Army Corps. Maneuvers proved to be an exciting and valuable experience. When they

(*Continued on page* 28)

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WILLARD STRAIGHT HALL

H. H. WILLIAMS, '25, Director

Lasher wins War on Weather!

For years, telephone cable has been hung by stiff wire rings from its supporting strand. But repeated expansion and contraction caused by temperature changes sometimes proved too much for even the best cable sheath. Fatigue cracks developed near the poles—this meant leaks—possible service interruptions—expensive repairs.

Recently, men of the Bell System developed a machine that lashes the cable and strand together in such a way that the concentration of strains near the poles is minimized. The Cable Lasher has also proved a great aid in the speedy installation of some of the new cables needed for airfields, camps, bases and war factories.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the College and the alumni."

President's Message

Fellow Cornellians:

WHEN a young man matriculates in an engineering course, he seems to think that all he has to do is to wish that he may be an engineer and that in due time he will be one. Doubtless he gives little thought to that which is expected of him when he finally comes to that point where his Alma Mater is willing to put her stamp of approval upon him and to signify by a diploma that he has successfully completed the course which those in authority have designed to produce an engineer.

But does the mere completion of this course in fact produce an engineer? Or does the passing of an examination of a State Board create an engineer? It may be that an individual through feats of memory, ability in mathematics and the use of physical and other formulae or other similar functions can answer those questions propounded to him in quizzes, finals, or other written examinations. But these do not make an engineer. After a few years of apprenticeship, he approaches that time when in reality he may reflect upon his status. He may then be called upon to develop something novel. He may be asked for an opinion upon some new form or some new design. He may be projecting some unusual development in which there is a difficult feature for the solution of which there is no charted path. Will he then measure up to the real requirements of an engineer? Will he be able to speak for himself and point the way? Then will come the time when he will be able to answer for himself whether or not he is an engineer.

It is not too late nor is it too early for students to be giving heed to the future. What a future! Who knows what it may hold for the coming generation? A world devastated of all that is good; a world groveling in the throes of wasted life and substance; a world grasping for a foothold; a world gasping for its very breath of life. It may be that the complete devotion of effort and energy to the construction of engines of destruction, with no thought of those things which will lead to better things in life, better living conditions, and the up-building of humanity, minds may become narrowed and men may even degenerate as a whole. The will to develop fine things, the will to research for those things which will prolong human life and weave into the fiber of mankind enduring things may be completely stifled, and there can be a period of complete stagnation, if not one of real decline.

This war will end in the twinkling of an eye, and there will come simultaneously a cessation of the production of the destroyers of life and property. With this ending there will be unleashed a mass of humanity which has been keyed up to the highest pitch of production; with this ending there will come the end of unlimited employment; with this ending will come the necessity for adaptation to new methods of producing and of living; but above all there will come a steady march back home of millions of young men, some whose ambitions may have been thwarted by their entrance into the war, some who will no longer be able to continue their inclinations, some who may find it difficult to establish themselves. An awful picture it is when fully contemplated. But it must be observed, it must be studied, and plans to make a stalemate impossible must be laid down now.

So you men who call yourselves engineers, and you would-be engineers,—here is a real job for you. Here is the chance to demonstrate that you are engineers. It will be the engineer who will produce the plan to absorb this vast army of men; it will be the engineer who will find new ways to utilize the skill of men and the brawn of men; it will be the engineer who will develop new ideas and new things which will appeal to the mass of humanity and start the economic wheels of supply and demand; it will be the engineer who will have the ability and knowledge to resurrect those things which will have laid dormant during the duration. Will the engineer be ready? This is the question which must be answered by the coming generation of engineers. They will be ready if they take the time to envisage the future and begin to plan; they will be ready if they do not await the morrow; they will be ready if they will do today that which they know can be done today. Think, engineers, of this awful, this great future, of this wonderful opportunity for service. Think—and act.

It Pays To KNOW About ZINC

In the period of America's greatest industrial development, ZINC rendered indispensable service; it is reasonable to expect that it will be utilized even more extensively in the greater developments yet to come.

ZINC has now gone to war, as an essential element in every form of fighting equipment, on land and sea, and in the air. In times of peace, it is used in an almost infinite variety of applications, from the tiny elements of zipper closures to protective coatings for the hulls of the largest ocean-going ships. You can't get away from it—ZINC comes into intimate touch with the life of every individual.

The Zinc industry itself is earnestly and wholeheartedly striving to do a worthy job in supporting the nation's war program. It is also anticipating and preparing for the day when Victory is won, when new problems must be solved.

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Will you be prepared with the knowledge you must have to solve the problems of the future?

ZINC is a material that it pays to KNOW about. You can get some interesting and very valuable data from these booklets, which will be sent to you free:

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THE COLLEGE . . .

Hart Speaks

(*Continued from page* 15)

non-essential products. Among these were the wire-mesh cable covering now taking the part of asphalt-impregnated burlap which was obtained from India and is now impossible to get. Plastic telephone frames are replacing the zinc-aluminum alloy formerly used. Numerous other examples were also cited.

During the latter part of the period a film was shown, entitled "The Telephone Arsenal." Originally made to be shown only to employees at Western Electric to make them realize their important function in the war effort, this film showed how industry is doing all it can to accelerate production of essential war materials.

The Societies—

ASME

DURING the month of March, two motion pictures were shown to the ASME. The first, a sound movie, entitled "The World's Largest Electrical Workshop," was lent by the General Electric Company. The film showed views of various General Electric factories, pointed out their differences, and also considered the problem of research and production.

A week later the ASME members saw a film donated by the Pioneer Parachute Company showing the latest parachute models. The picture showed the operation of the Pioneer parachute testing tower. A parachute is hung on a rotating boom, supported by a tall tower. A motion picture camera is so arranged that when the parachute is released, the opening and descent of the chute are photographed in order to find defects, and to open the road for improvements. Several other scenes were shown, illustrating how a commercial parachute is likely to fail and how a parachute is packed. Also shown were some scenes of the parachute troops of the United States Army.

ASCE

AS a part of its program for greater activity on the part of its members, the ASCE recently brought out the first issue of its new publication, "Rivet Rattle". The initial number, a three-page mimeographed affair, came out on March 18. The chief articles of interest were a discussion of the talks on tunnels given by Ole Singstad, chief engineer of the New York City Tunnel Authority, and of the March 24 speech by C. E. O'Rourke, professor of structural engineering, on "Bombs, Bomb Effects and Bomb Protection."

Engineering Corps

THE engineering corps of both the Army and the Navy were discussed at the March 13 luncheon meeting of the Cornell Student Chapter of the ASCE, held in Willard Straight Hall. Fred Burton, CE '42, president, and Jerry Cohen, CE '42, the newly elected secretary, led the panel. The discussion included an account of the work being done at present by each organization. Professor John E. Perry, the personnel officer of the School of Civil Engineering, clarified the position of a newly-graduated civil engineer with respect to these two corps.

O'Rourke Speaks

"BOMBS, Bomb Effects, and Bomb Protection" was the subject of a talk by C. E. O'Rourke, professor of structural engineering, at a meeting of the Cornell Chapter of the ASCE on March 24. His discussion covered the main types of bombs, their construction, and the means by which they produce their destructive results. He also reviewed the structural methods used in the design of bomb shelters for the protection of existing buildings, and in the construction of new buildings.

The lecture included the highlights of a thorough study begun last fall by Professor O'Rourke at the request of Dean Hollister. This study has been based on extensive tests made by the government and on the investigations conducted by British publications to determine actual wartime bombing results.

The four main types of bombs discussed were demolition, fragmentation, gas, and incendiary. The means by which these bombs produce their destructive work vary with the type, size, and method of firing and the types can be divided into impact, earth-shock, blast, and fragmentation. Impact applies mainly to direct hits, while near-misses produce earth-shocks which are decidedly destructive to foundations and walls. Blast destruction is produced by air waves, and fragmentation is caused by flying pieces of shell. In order that proper methods be used to resist these means of destruction, the effects and magnitudes of each of these types of destruction must be known. With this knowledge, shelters can be built to resist all the effects, and parts of existing buildings can be made safe against all but a direct hit. In addition, new buildings can be constructed to minimize the damage done to human life, the building and its equipment.

Defense Courses

THE United States Office of Education is sponsoring tuition-free courses for residents of Ithaca and vicinity who are in war industries or desire such employment. On Wednesday evenings from 7 to 10 o'clock, classes in Principles of Electrical Engineering, requiring two years of college engineering; Personnel Management, also requiring two years of college training, plus practical experience; and Time and Motion Study, requiring some sort of previous training, are held in the College of Engineering.

Cornell is also sponsoring tuition-free Radio Technician Training courses

Directional Drilling

(*Continued from page* 10)

ela and Rumania.

By this far reaching method of controlled directional drilling, geologists have once again been forced to alter their pessimistic prophecies that the oil deposits through the world will shortly be exhausted. After the war, exploitation by this method of the shoal waters of the Black Sea, the Caspian, the Persian Gulf, and Maraciabo—Venezuela's great inland sea—promises to add years to the world's oil resources.

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ENGINEER BOARDS

Sfat

(*Continued from page* 16)

Michigan. In his opinion, the time spent in this work was profitable. Besides learning a trade and working outdoors, he learned to "speak a different language" and began to look at matters from a practical as well as a theoretical standpoint. He liked the work so much that he returned to it at the end of his third year.

Mike's junior year at Cornell was occupied chiefly with study and work on the ENGINEER. At the ENGINEER banquet during the latter part of the year came the announcement he had hoped and worked for—he was named editor-in-chief. Since then he has put his efforts into doing a thorough job on the magazine. At the end of the year, he was on the Dean's Honor List for the third consecutive year.

During this last year, he has guided the ENGINEER to heights of success and has shown many of its younger members that it can still go much higher. He has remained steady in the face of many personal worries and difficulties. He promoted the magazine at the national convention of the Engineering College Magazines Associated at Urbana, Illinois, and is even now spreading its influence by serving on the publicity committee of the Engineer's Council.

Mike hopes eventually to enter the field of technical journalism or production management. At present he hopes to get located in the South.

Otto

(*Continued from page* 17)

wooded area so that the students would be shaded from the hot Aberdeen sun. In addition to the saplings was some uninvited poison ivy; it took one week's application of potassium permanganate together with several injections to drive the stuff away.

After the war you may find him a grimy engineer standing by a rotary rig in Texas or in the comparatively cleaner, yet no less interesting, field of engineering journalism.

Boyer

(*Continued from page* 16)

and worked on the final design. He said he had a swell time at this.

Joe's three main interests are engineering, Ford cars, and night clubs (only the business end). He has owned six Fords so far, starting with a '32 V-8, once owned two at the same time. He likes to tinker around with them and says he is the repairman at his fraternity in an "advisory" capacity.

Walker

(*Continued from page* 17)

a point south of Jacksonville, Florida, in the record time of two and two-thirds days. From that point, they cut down their pace and proceeded down into Miami, thence over to St. Petersburg, and up the west coast of Florida reluctantly turning north and getting back just in time for college. All this happened in 21 days.

Ernie graduates this year and goes forth to new and greater adventures. He takes with him all the best wishes of those who came in contact with him.

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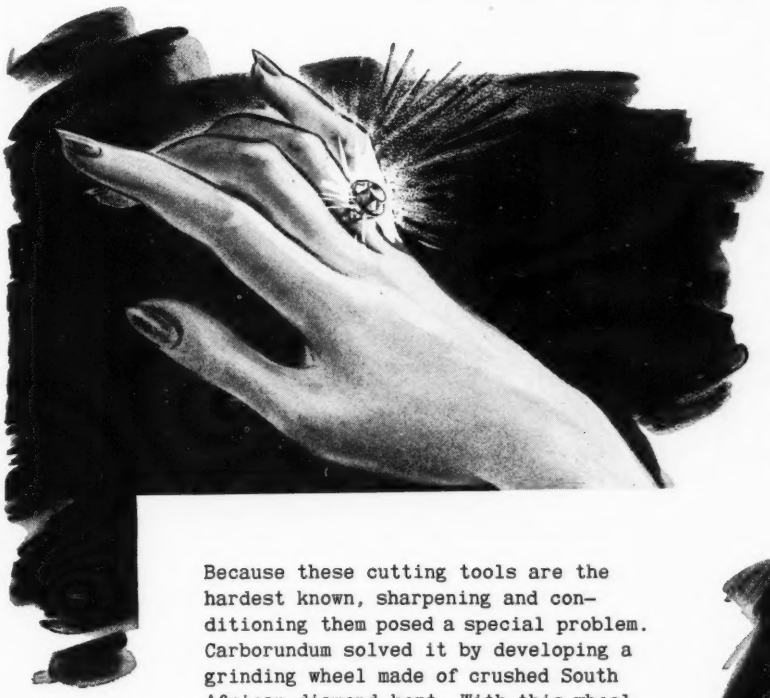

This is a war of machines. And one of its decisive battles is being fought in the tool rooms of America — with diamonds as weapons! For the high speed production of alloy steel parts depends on cemented carbide cutting tools. Tools so hard that only diamonds can give them the fine, true edge necessary for efficient cutting. Thus Carborundum Brand Diamond Wheels are playing a vital part in helping America re-arm.

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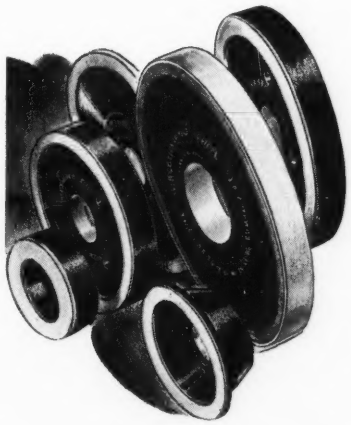

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Wartime Functions

(*Continued from page 7*)

cross. Engineers have been employed in this service.

Further, assault boats—pneumatic and otherwise—have been used recently in the German and Japanese Armies. These have been apparently considered as engineer bridging units and are manned by engineer personnel. Pending the construction of permanent bridging, the engineers may build rafts for the purpose of carrying heavier equipment across rivers.

In the case of retirement, where the greatest delay of the enemy advance must be made, engineer demolition squads are most essential. Bridges must be mined and demolished when the last of the defending troops are withdrawn. Tank blocks and obstacles such as trees felled across the road must be provided. Roads may be blown up, particularly at crossroads. Contact mines must be spread. Railroad metal, frogs, switches, bridges, buildings must be destroyed. The writer remembers the road from Valenciennes to Mons in November, 1918. All the trees had been felled across the road by the Germans. The narrow gage railway (1 meter) along the roadway had had every alternate rail joint on both lines of rail blown so that every rail was useless. In retirement the work of the engineers is only limited by the time available and the explosives obtainable. Picture of a blocked road is shown in Fig. 2.

After "Digging In"

After the stalemate trenches must be made habitable and communications improved. From engineer stores sandbags, revetting material, trench mats or walkways, flying traverse and trench block material will be provided for trench use. For protection of men off duty trench shelters and dugout construction must be provided. For machine gun, trench mortar, and similar emplacements, material is provided by the engineers. Gun emplacement material is provided for the artillery, hutting, horse line, and other protection for men, animals and equipment is provided for the reserve or rest areas. The writer's company made many small trench stoves out of thin steel plate and oil drums during the winter of 1916 for the troops in the forward areas. The engineers provide barbed wire, steel and wooden stakes both for wiring front line work put up by the infantry and also for support, reserve, and switch lines which were usually directly considered as more directly under the engineers. Overland trails are provided for night work. Waterpipe lines to the trenches and to rear filling stations are provided when the facilities

(*Continued on page 30*)

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THE ALUMNI . . .

(*Continued from page* 18)

were over, I was stationed at Camp Shelby, Mississippi, until the middle of November, when I received orders to sail for Panama.

"The aircraft warning service to which I was assigned is a part of the Panama Interceptor Command. The work is very secret in nature, but I can divulge that it is very interesting and has gotten me around to many places most officers don't have a chance to see.

"I have been to, lived at, or worked at, just about every post on the Isthmus. In my travels, I have flown over a large part of the Republic, have travelled up and down its coasts in many different kinds of boats, and have been driven over many of its roads, such as they are. For over a month I have lived in jungles and traveled through the jungles throughout the Republic. I have made friends with Indian chiefs and native officials. It is as if the pages of the National Geographic had come to life before my eyes. I haven't missed any of the interesting sights in the zone either. I took in a gala festival they hold in Panama City every year and have also taken in many of the night clubs and hot spots. Yes, I even saw the president of Panama.

"I have just been transferred to the First Reporting Company and was very much surprised to find that the battalion commander is Major Larew, my R.O.T.C. instructor at Cornell in 1937. Headquarters are at Fort Clayton, but I have had a very nice cottage for quarters at the post of Cowjal, 2 miles away.

"Just before war was declared I ran across Jack Antrim, Charlie Odenbach, and about six or seven more '41 Cornell engineers down here. Except for Jack, who has an A.E.M.E. degree, they are all CE's and are surveying in the jungles for the Department of Engineering. Dick Durbin is at Camp Haan, California, in the 504th Signal Aircraft Warning Regiment, doing work similar to mine. He tells me that Jim Robinett is at Fort Bragg; Dick Stimson, Ken Robinson, Bob Meacham and a couple of other Cornell men are living in North Hollywood, probably working in aircraft plants. Jack Robinson is working in Washington on the War Production Board as a Lieutenant. Dick Cosel is an attache in London. C. Eldridge is with a Signal Battalion in the Carolinas as a motor transportation officer. Rodge Scott, Bill Kirk, Bob Hoyle, and several of the others are at Wright Field in the Material Division of the Air Corps. That's all the information I can remember about the engineers of the Class of '41; I have, however, heard about and run across many more Cornellians."

Sincerely,

(*signed*) *Bob Ross*

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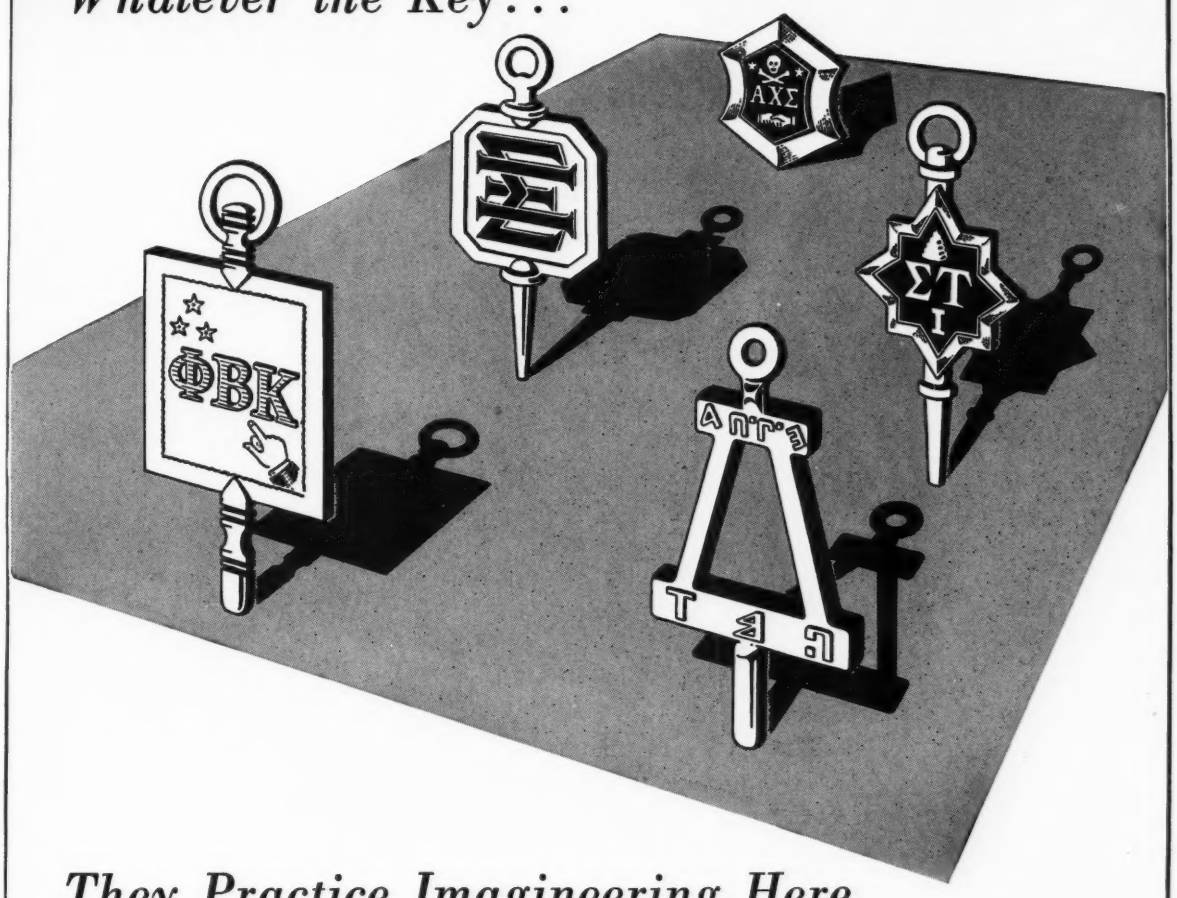

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Keys don't make the man. We mention them only as a handy way of getting at the interesting fact that it takes all kinds of men and *of knowledge* to make an organization, such as Alcoa, tick.

The striking thing is, how soon most of our men shed their specific labels after they come with us only to discover how much more *exciting* it is to practice Imagineering.

There aren't any grooves to Imagineering. There aren't any limits, either. A man lets his imagination soar and then engineers it down to earth. When he comes down he is just as liable to find himself in a new department, with new responsibilities, and a new set of conditions on which to practice his Imagineering.

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ONE PAGE FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

(*Continued from page 26*)

permit. In helping Signals, the writer's company in 1916 buried the first armored cable used on a brigade front in the British Army on the western front from the front line units to battle headquarters of the brigade.

Deep dugouts are of great value and the divisional engineers made a great many in the last war. When an attack was premeditated, or after a very severe bombardment, the corps often assisted the units in the forward area with personnel from the tunnelling companies. In this connection dressing stations were constructed in suitable localities.

Drainage was of considerable interest to troops holding the line, and engineers were called upon for advice and assistance. Normally the front and support line work fell to the lot of the units holding this line, and the reserve lines—and particularly the communication trenches—were considered to be the work of the engineers.

This rather sketchy resume of the work of engineers in war would not be complete without a few words on the "set attack" or "limited objective." When it was decided that a trench position could be bettered or that it was necessary as part of the attrition program to take from the enemy part of his trench position (or even in the preliminary stages of a grand offensive), limited distances were assigned, since the major trench systems often had to be crossed immediately.

Before and After Attack

In this case the engineers have considerable work in advance of zero hour in forming advanced engineer dumps of material, establishing jumping off trenches, protection of troops of concentration, advanced water installations, reconnaisance for new sources of supply, provision for troops of all kinds to cross trenches, cutting wire for the advance, constructing and making signboards and direction markers for captured trenches and similar projects.

When action has taken place, the engineers will be utilized for water installation work, for communication trench work, for construction of strong points or points of resistance behind the new support lines, for repairing and improving dugouts captured from the enemy, and for carrying forward the trench tramway systems. They should look for and dismantle mines, boobytraps, etc.

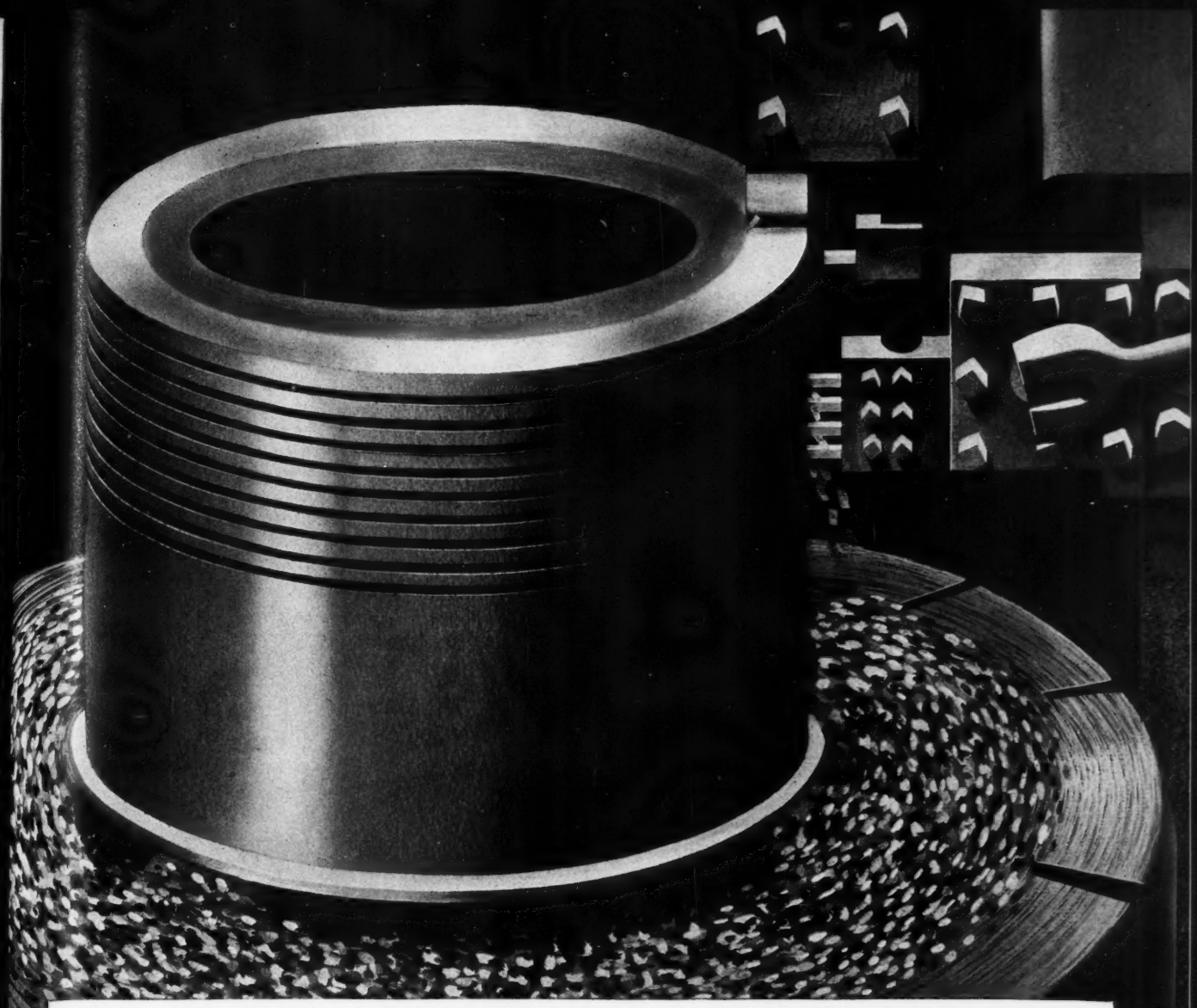
The corps engineers will likely extend the corps tramways systems, repair roads not in the divisional areas, repair railroads if they can be utilized and start on preparations for second and following attacks.

In these attacks the engineers should be kept for special technical work. They should not be assigned to commanders of the attacking troops, but should be held under the command of the divisional engineer officer or corps engineer officer to be dispatched to their specific jobs when the situation permits. Until such times, they will act as reserves.

In these actions the engineers should be reinforced by infantry to act as carrying parties and to do rough manual labor.

We specialize in satisfied customers with the best in service and products. Come in and be convinced.

R. T. G.
Esso Service Station
Phone 2872 335 E. State St.



HOW TO SEE RED...AND LIKE IT!

Friction . . . arch enemy of *speed* in the machining of iron and steel . . . meets its match in cutting tools made of Haynes Stellite non-ferrous alloys. For these alloys . . . of cobalt, chromium, and tungsten . . . have the amazing property of "red hardness." Unlike cutting tools made of ordinary metals, they *keep their edge* . . . and keep on cutting . . . even when friction heats them *red hot.*

Making possible tougher, longer-lasting cutting tools is only one of the vital roles played by Haynes Stellite materials. Because they stand up under heat, abrasion, and corrosion, they are used to hard-face many different kinds of metal parts.

Oil well drilling bits . . . steam shovel bucket lips . . . heavy gears . . . shafts . . . airplane and truck exhaust valve seats . . . crusher blades . . . mixers . . . plowshares . . . and other pieces of equipment that must withstand steady punishment have their lives lengthened . . . and their efficiency stepped up . . . with welded-on hard-facings of Haynes Stellite alloys.

Use of Haynes Stellite alloys speeds up production . . . lowers production costs . . . saves on tool and part replacements . . . reduces time lost while replacements are being made. In the fabrication of new parts, base metals can be selected for such valuable properties as strength and ductility—without particular regard for wear-resistance—because they can then be armored against abrasion, heat, and corrosion by hard-facing with Haynes Stellite alloys.

Further savings can be made by the use of these alloys because worn parts can be *renewed,* instead of being sent to the scrap pile . . . thus eliminating replacement with materials hard to obtain.

Faster production . . . conservation of metals . . . lower costs . . . these are the contributions made to industry by Haynes Stellite alloys.

. . .

The development of Haynes Stellite Company alloys and hard-facing practice has been furthered by the metallurgical knowledge of Electro Metallurgical Company, by the research facilities of Union Carbide and Carbon Research Laboratories, Inc., and by the service organization of The Linde Air Products Company—which companies also are Units of Union Carbide and Carbon Corporation.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

KOKOMO, INDIANA NEW YORK, N. Y.

STRESS and STRAIN...

Before March 13 a year book cost $7. After that they cost $10. If you bought one before March 13, you saved $3. If you didn't buy one you saved $7. But if you waited and didn't buy one at all you saved $10. Total saving—$20.

Ben: I know a good joke about crude oil.

Carey: Spring it.

Ben: It's not refined.

Wuz dat yo' bes' girl fren'?
Oh, no; jes' necks bes'.

The consulting engineer walked brightly into his waiting room.

"Who's been waiting longest?" he asked cheerfully.

"I have," said the tailor as he presented his bill.

Young man, I understand that you have made advances to my daughter.

Yes, sir, I wasn't going to say any thing about it but now that you have, I wish you could get her to pay me back.

Why is it that you are always at the bottom of the class?

It doesn't make any difference, Pop. They teach the same things at both ends.

Dedicated To The Spring Recess

Officer (to man pacing the sidewalk at three in the morning): What are you doing here?

Gentleman: I forgot my key, officer, and I'm waiting for my children to come home and let me in.

"First it's cats and kites; now it's you guys."

Courtesy Public Utilities Fortnightly

Sailor (home on leave): I met my old girl today. Haven't seen her in ten years.

Friend: Has she kept her girlish figure?

Sailor: Kept it? She's doubled it.

She was trying to work her way through college selling Saturday Evening Post, but all the fellows wanted to take Liberties.

Small Boy: What is college bred, daddy?

Daddy (with son in college): They make college bread, my boy, from the flower of youth and the dough of old age.

It takes an income of six figures to get a man in the rotogravure section, but one figure will get a girl there.

How's Collins?

Flat on his back.

Why, only last night I saw him dancing with a blonde.

So did his wife.

Cadet Officer—"Are you smoking in the ranks, frosh?"

Frosh—"No, sir, that's the fog I'm in, sir."

At her request you gave up drinking?

Yes.

And you stopped smoking for the same reason?

I did.

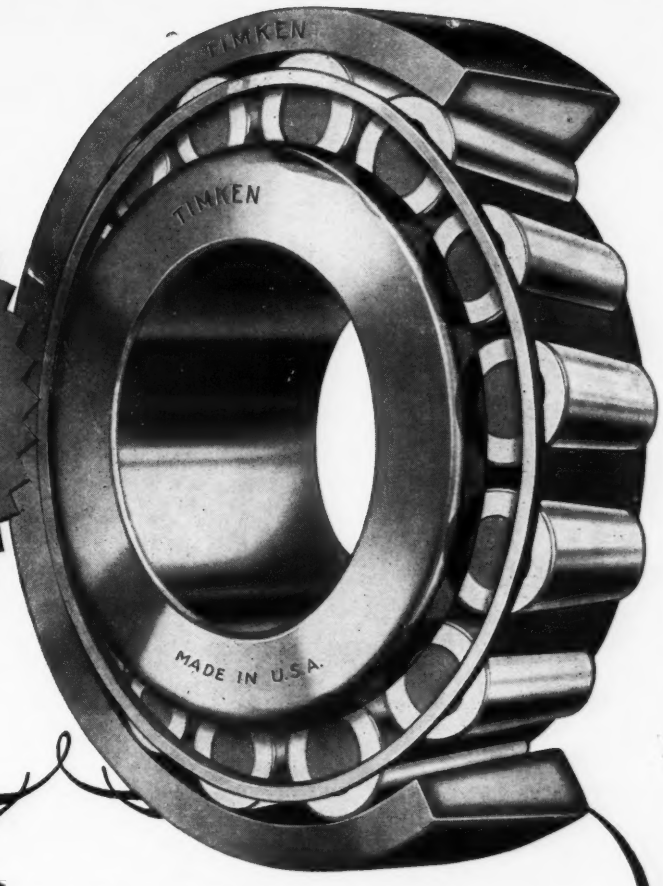
And it was for her you gave up dancing, card parties, and billiards?

Absolutely.

Then why didn't you marry her?

Well, after all this reforming I realized I could do better.

TIMKEN BEARINGS are helping engineers to design for Victory. They will help them to plan for prosperity when the war is over.



Engineers responsible for the design of American mechanized armament and the machines that make it have found that they can successfully meet every bearing requirement with one kind of bearing—the Timken Tapered Roller Bearing.

Friction elimination; precision; radial, thrust and combined load capacities; maintenance of alignment of shafts and gears; all of these qualities are inherent in the design and construction of the Timken Bearing.

You never may be called upon to design military equipment, but a thorough knowledge of the Timken Bearing and its universal application will be one of your most valuable assets no matter what branch of mechanical engineering you eventually may enter.

We always will be glad to give you any information you may require —including the solution of specific bearing problems.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

G-E Campus News

NAVY CLASSROOM

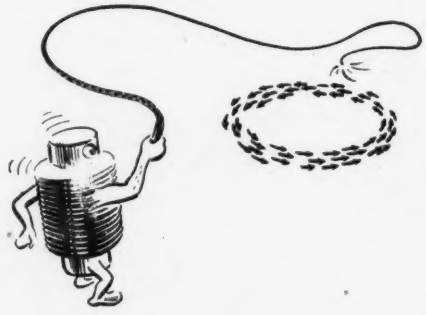
A U.S. submarine is essentially an electric-propelled vehicle, and an amazing amount of electric equipment is packed away in its steel hull. Responsibility for operation, maintenance, and repair of all this electric equipment is in the hands of two classes of petty officers—chief electrician's mates and electrician's mates first class.

For years General Electric has collaborated with the Navy in providing instruction for such men. They are shown how all kinds of equipment aboard their ships is built and assembled. Thus petty officers are better qualified both to care for electric propulsion and other apparatus in normal service and to repair it in case of emergency. This training has lately been accelerated. G-E plants are seldom without groups of these visiting Navy men, and in the past two years more than 50 petty officers have taken the "course."

100 TIMES TOO BRIGHT

IN the early days of electric lights, economical city fathers used to turn out the street lamps on nights when there was a full moon. For the best blackout techniques today, even moonlight is 100 times too bright. But although air-raid wardens can't do anything about the moon, for overcast nights General Electric's illuminating laboratory has developed a special street light which produces illumination about equal to starlight.

The fixture contains a 10-watt lamp, so concealed that the only light visible comes through a circular narrow piece of plastic around the side. A projecting black canopy screens the light from the eyes of aviators. The light output, equivalent to that from a single candle flame, seems at first sight to be practically zero. But after a little time eyes become adjusted, as they do in a movie theatre, and objects can be dimly seen 30 to 40 feet away. Specifications for the new lamp are based on the experience of the British in their blackouts.



ELECTRON WHIRLIGIG

WHETHER you call it a "rheotron" or "betatron" or by its longer name of "induction electron accelerator," a new science tool recently built by Dr. Donald W. Kerst in the G-E Research Laboratory is one of the world's most potent merry-go-rounds. On it, electrons ride to a speed closely approximating that of light — equivalent to that produced by 20 million volts. Copper bombarded by these dizzy, super-speed electrons becomes temporarily radioactive, and other interesting possibilities are being investigated.

Dr. Kerst, young professor at the University of Illinois, got the idea for the device, built a small model, and came to General Electric to build a bigger one. Like the much-publicized cyclotron, except that it accelerates electrons instead of positive ions, the device chases the charged particles round and round in a magnetic field, adding to their speed at every revolution. Scientists are reticent about predicting what the rheotron's chief use will be, but it is promising enough so that a bigger one is being built in the G-E laboratory for speeds of 100 million volts.

GENERAL ELECTRIC

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